TEMPERAMENT DISEASE & HEALTH

CHADWICK

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For
Dr Boyer
from
Mrs F. E. Chadwick
July 1900

TEMPERAMENT, DISEASE AND HEALTH

BY

FRENCH ENSOR CHADWICK

COMMANDER U.S.N.

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TO THE MEMORY OF

SIR EDWIN CHADWICK

the father and foremost promoter of modern social science; the record of whose active work, beginning in 1828 and ending only two years since, when he died at the age of ninety, is well named by Dr. Benjamin Ward Richardson, his biographer, The Health of Nations.

The author is glad to bear even so small a tribute to one who honored him with an affectionate friendship: kinship he cannot claim, a separation of family by the Atlantic for two centuries barring a claim he would otherwise be proud to make.

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TEMPERAMENT, DISEASE, AND HEALTH.

INTRODUCTORY.

THIS little book is written primarily to put forward two ideas. First, that there is associated with temperament a specific rate of change; secondly, that the failure to keep up that rate, or, in other words, a failure to have elimination keep pace with accession of material, is the primal cause of organic disease.[1] The latter idea is not new in the sense that the necessity of removal of waste material has always been recognized, and much has been written of late years as to the formation, through defective elimination, of poisonous alkaloids in the body; but it is new, so far as the author knows, in giving it the importance mentioned.

[1] This theory was first advanced by the author in a pamphlet printed for private circulation in 1889.

The author has a natural diffidence in treating such subjects, as treading on ground which, it is generally supposed, should only be occupied by specialists. What is said, however, is the outcome of a number of years' thought on the questions treated, and facts are dealt with which are open to all men to know and to deduce opinions therefrom.

Certain recommendations are the result of actual personal experiment, by which is meant that the author has regulated his own health by the theories advanced as to health-keeping, and has made the apparently simple, but really far-reaching, rules laid down the basis of his own manner of life.

We are rapidly coming to recognize the simplicity of the methods of nature's workings. The same direct forces work, and work in the same manner, in the protoplasmic unit as in the man, or whale, or flower, which are all only the resultants of an aggregation of such units. To know the manner of this working is

an absolute pre-requisite to the establishment of scientific hygiene; and that we may come to know is possible. The origin of these units, the origin of life, is another question.

In the world of medicine something has been arrived at by sheer force of experiment. But when we know that in all the vast list of the pharmacopœia there are but two things—quinine and mercury—which can be named as specifics, surely curing certain diseases, all can readily understand how largely what has been called the science of medicine has been so far only a groping. The outcome of the great discoveries of Pasteur and his co-laborers will, however, undoubtedly be to put the curing of certain diseases by medicine on a logical basis, and will also as surely put an end to the whole monstrous system of nostrums to which our own people, perhaps more than any other, are addicted. The only sure things on which to lean are good food, good air, good clothing, and that real cleanliness spoken of later.

The author makes no pretence to original investigation in the subject of bacteria, and has endeavored to make the chapter treating of micro-organisms a *résumé* as much as possible in the words of recognized authorities.

If what is said will aid any one towards sound health, the one supreme good from the ordinary practical standpoint of our daily existence, the author will feel well repaid. That the field for improvement is large, will be acknowledged when it is understood that not less than one third of the mortality in even the most highly civilized countries is still due to preventable disease, though the mortality of England was in 1889 but half per thousand that of the period 1746–1755—viz., 17.85 against 35.5.

"In some parts of England where the main object is recovery or maintenance of health, the death-rate is down to 9 per 1,000. While in others, where the main object is manufacture and money-making, it is as high as 30 per 1,000."[1]

[1] Sir Joseph Fayrer.

The mortality of our own country is quite one third higher than it should be. Our saving in cost of funerals which should not take place, loss of wages, through sick-days which should not be, may be estimated on good authority at about $125,000,000 per year. But what estimate can be made of the anxiety and anguish, or what measure made of the misery, the want, the sin, which follow in the paths of this pestilence which our ignorance allows to exist?

Who can gainsay, in the face of such figures, that our first duty is to keep well? that disease which can be prevented is a crime both against ourselves and the State?

I.

MRS. HELEN HUNT JACKSON (H. H.) began a very excellent and characteristic article on Southern California, with the remark: "Climate is to a country what temperament is to a man —fate." Underneath this statement lies a philosophy which we are slow to recognize, but which we shall more and more come to know, viz.: that there is a physical power acting differently in each individual which determines irrevocably and absolutely our type of personality; that in the words of an old writer, though not using here his own application, "You are what you are, what you are in the sight of God, that you are." [1]

We have given the vague name Temperament to that special nature which appears in the individual whereby one is full of impulse where

[1] *Imitation of Christ.*

another is calm; one is rapid of thought and speech where another is slow; one is sanguine in all his undertakings where another is cautious and doubtful; it is, in fact, the summation of physical and mental peculiarities. What then is the basis of this difference?

I venture to offer a theory regarding what may be at least one element in its determination, viz.: that it is to a very large degree dependent on the rate of molecular change in the physique. I use the word molecular as a convenient term to apply to the living protoplasmic unit or particle which goes to build up any part of our bodies.

That each individual has his own proper rate of change or renewal would seem more than merely probable. We differ enormously in the amount of food we find necessary to take; in the frequency with which we must take it; in the activity of our skin action,—in the rate, in fact, of all our physical processes.

In the active, sanguine temperament all

these processes are more rapid than in what we know as the slower temperaments; digestion is quicker, food must be taken at shorter intervals; such persons must sleep more and also more frequently; are more quickly pulled down in illness and are quicker to convalesce.

Many men of slow temperament take but one meal a day. It is a subject of wonder with such and somewhat of scorn that other men should wish food as often as three or four times in the twenty-four hours. With these slower temperaments all the functions are slower; the records of observations show some very remarkable examples bearing upon this.

Is it thus not reasonable to suppose that the body itself changes more slowly in such men than in the case of those in whom all the well-known and more marked functions are more active and rapid; and if this association does exist, have we not here one of the determining factors of our type of character?

My own observation during a number of

years goes to show that when there is great slowness of digestive action, as shown in the ability to go without food for an unusual time without serious inconvenience, this slowness is very apt to be accompanied by power to sleep at will; and in all cases where I have found these two qualities together I have found either gray eyes also associated, or, very rarely, gray shot with brown; the purer the gray, however, the more strongly marked are these characteristics. The number of observations which I have made in this regard is very considerable, and I have thus far found no exception.

Napoleon I., it may be stated, was an excellent example of this make-up, in whom the ability to command sleep and go without food, and withstand great fatigues, was very marked. Washington and Wellington may also be cited, and in all these great commanders gray eyes were associated with the two physical qualities mentioned. The eyes thus tend to mark the temperament, and it would be curious to tabu-

late the color of the eyes in those who have successfully borne the burdens of great commands.

As staying power is naturally largely dependent upon ability to withstand great fatigue, which latter quality is as naturally based upon ability to go long without food and to sleep at will, we have here what is probably an easy means of judging of capacity in regard to such power.

I have nowhere found the color of the eye mentioned as an indicator of temperament, but I am convinced that it is by far the most important and suggestive. Dr. Jonathan Hutchinson[1] says: "I . . . assert that whoever will set himself to classify by temperament a dozen healthy individuals whom he may chance to meet on a steamboat, in a law court, or at a dinner party, will find that he has secured scarcely any data excepting those of complexion. He will

[1] *The Pedigree of Disease: Six Lectures on Temperament, Idiosyncrasy, and Diathesis*, 1881.

find, moreover, unless I am much mistaken, that if he attempts to go beyond mere complexion, there are not more than two or three in a dozen whom he can with any degree of confidence assign to special temperaments. As to complexion itself the further he goes the more he will have to confess that putting various conditions of sanguification aside as being in many persons dependent on varying states of health, he can after all classify the complexions themselves only in reference to pigmentation. The varying degrees of dark, fair, or red constitute almost the sole individual peculiarities of the complexion which are not altered by disease or diet."

The Doctor, besides leaving out the eyes as especially indicative, omits texture of skin, which in one instance at least is of a very marked character, viz., that in the complexion termed by the French, *mate*, the smooth colorless marble-like texture which is also generally associated with eyes of a marked gray.

A cognate inquiry, and one especially which has a bearing upon the subject of bacterial influences, is the question of chemical differences which has been advanced as a basis of temperament by Dr. Paul Gibier of the Pasteur Institute in New York, in a paper read before the Tenth Medical Congress, held in Berlin in August, 1890, in which he proposed a division of temperaments into the—

1. Alkaline.
2. The Acid.
3. The Neutral.

He prefaced this division with the remark: "Do we not know, for instance, that an infinitesimal proportion of chloride of silver is sufficient to check the development of certain inferior organisms (Raulin), that glycerine introduced into a culture medium otherwise inert renders it capable of giving nourishment to the *Bacillus tuberculosis* (Roux and Nocard)? Do we not, moreover, know that when we have neglected to slightly alkalinize, or at least to

neutralize, an acid culture medium, the majority of pathogenic microbes decline to develop even when but traces of acidity exist?

"If it need so little to cause an inert medium to become unfit for the development of infectious germs, what may we not expect from our cellular tissues, which are struggling actively, and I venture to say intelligently, for the preservation of their collective existence which constitutes our own as a whole?

. . . . . .

"All substances from a chemical standpoint are alkaline, acid, or neutral, why should not the same hold good of those living animal substances whose functions are so varied?

"The blood is alkaline, and yet do not the cells of the glands, the muscles, and other tissues secrete liquids that are more or less acid according to individuals? These liquids are taken up again by the blood and eliminated by the sudoriparous glands, by the kidneys, etc., or partly deposited within the organs."

To paraphrase the further views of Dr. Gibier, people possessed of the alkaline temperament are slightly or not at all predisposed to affections of the joints, have no cutaneous diseases, and rarely any vascular or heart affections; are not subject to cancer, and seldom or never suffer from sourness of stomach; are not subject to rheumatism. They show, however, when living in cities peculiar aptitude for chest troubles, which tendency in his opinion is intensified by a vegetarian diet and an avoidance of fermented drinks.

The acid temperament is subject during youth to facial acne; the gastric juice is markedly acid, and during adolescence persons of this temperament frequently have acidity of the stomach (water brash). They are less subject to cholera and yellow fever, the marked acidity of the gastric juice causing the destruction of bacilli which have entered the stomach. Cutaneous affections are frequent, and in such persons we find headaches, and "the neuralgic

affections depending upon a cellular development of the central nervous system (general paralysis, scleroses, locomotor ataxia, etc.), together with neuropathic affections, hysteria, etc."

The neutral temperament is the happy mean, which "would correspond to the temperate temperament of the ancients."

This suggestion has much in its favor, and all later developments would seem to make for its truth. Among many facts of like nature going to prove its sound basis is that of the very marked difference with which different temperaments support the bites of insects, many persons, for example, being quite unconscious of annoyance from bites of fleas or mosquitoes which to others are an acute suffering; also the extraordinary differences in receptivity, by different animals, of poisons of certain diseases: thus the white rat is almost perfectly immune against the poison of anthrax (splenic fever), whereas the black generally succumbs.

Coming back, however, to the theory with which we started, and which is not at all dissonant with the latter, that we do change, is of course indisputable; whether rapidly or slowly, that change must be under law, which for any given condition would certainly seem to involve a specific rate as mentioned. Granted that there be this specific rate, a natural corollary would be that it must be kept up or disease would ensue through a failure to throw off with normal rapidity the particles which have lived, done their duty, and died. Otherwise a process would take place akin to the evils of stagnation in water, which, so long as it is running and thus aërated, is pure and wholesome, but when stagnant, becomes the breeding-place of unwholesome forms of life.

To deny the necessity of keeping up such a rate (if a specific rate exist), is to deny that injury does not necessarily follow violation of law, a denial which no one of this day will make.

I thus venture to define what is known as

"organic disease" as a failure in rate of change. And further, that, however associated, bacteria are the resultant rather than the causes of such diseases; that they are there doing merely their normal duty as scavengers and not with noxious intent.[1] I venture to assert that cancer, which is now regarded as "the formation of a new, more or less insubordinate, centre of development, the essence of the process" of which "is that certain of the epithelial cells of the part grow and multiply more rapidly than their congeners,"[2] is a most special instance of the truth of the theory proposed. I may incidentally say that the discovery of the "cancer bacillus" is announced from time to time, only to be denied; but that small specific organisms will be discovered to be associated with cancer is beyond a doubt; the disintegration of material and consequent putrefactive changes must have

[1] Or in general terms, those associated with chronic diseases are saprophytic and non-pathogenic.

[2] Dr. W. Roger Williams, F.R.C.S.

some such associated forms. It is a law from which there is no escape.

Man has yet to realize how evanescent a thing his body is. In what limits of time complete renewal may take place is, of course, far from yet being absolutely determined though very careful experiments have been made, and are still of course making, bearing on the subject. It is unquestionably very rapid in the softer parts, though slow in such as the tendons; and slower still, perhaps many months, in the case of the bony parts of our structure. In the case of the softer parts an entire renewal probably takes place in many within from six to eight weeks; even parts so hard as the nails will renew themselves in some within three months.

The epidermis, of course, which is the final resultant of the work of the physical structure, the jumping-off place, so to speak, is marvellously evanescent. We recognize this in the

popular idea regarding, say, an ink-stain: "Let it be, it will wear off in a day or so." And so it does wear off, because the cuticle containing it sloughs away from moment to moment.

Lest I be accused of grossly exaggerating our probable rate of change, I would cite the high authority of Sir Lyon Playfair, who, in a letter to the author, says "the entire nitrogenous material is changed in six weeks"; and I would beg to call to mind the estimate of Professor Atwater in the *Century* for June, 1887, in which he gives the total daily income of a well-fed laborer as 96 oz. of food and drink and 30 oz. of oxygen, or a total of $7\frac{7}{8}$ lbs. The outgo excreted through the lungs and skin he gives as $51\frac{1}{2}$ oz., or about 40 per cent. of the total, 126.2 oz. These great amounts must surely indicate a much greater molecular activity than has been popularly supposed.

That we recognize empirically the truth of the necessity of keeping up our rate of change,

is shown in the fact that exercise, Turkish baths, and massage are regarded as of great benefit and are largely used as a means of restoring health. The *raison d'être* of the use of such means can only be that they induce an augmentation of molecular activity and cause a removal of dead and stagnant particles; the movements of the muscles in exercise, for instance, constituting a pumping action by which waste products are "pumped out of the muscles at each contraction and sent onwards into the large lymph spaces and lymph channels." [1]

We are thus not fixed entities, as most of us are apt to consider ourselves; nor have we the gratification of even thinking ourselves here for the formerly supposed seven years at least. Every moment there is the death of a portion of our bodies; every moment there is new life added to them. Death and life are as intimately associated within us as individuals as

[1] *Animal Alkaloids.*—Sir William Aitken, M.D., F.R.S.

they are in the vast river of humanity constantly disappearing and as constantly renewing itself through the ages, and which at farthest in any given hundred years is itself entirely renewed.

II.

THE association with disease of certain microscopic forms of life is now an accepted belief, founded on facts which appear irrefutable. It is not a new theory, as it was advanced more than two hundred years ago, when Leeuwenhoek (1683) "with his single lenses first saw bacteria in the mouth." It had, however, a very unsteady and insecure existence, though a gradually growing one, until within our own epoch, when it assumed a new stage of development, and in the years since 1840 has strengthened with great rapidity under the hands of the great masters of investigation, of whom Pasteur and Koch are representative. The first named will probably be always the foremost of those associated with the work of establishing this momentous revolution, which, whatever development it may have hereafter,

will build upon the foundations now securely laid by the present French and German schools of investigation.

Put into as few words as possible, it is that each disease or group of diseases has associated with it a specific micro-organism, which beyond doubt in some cases is the cause as well as the associate of that disease. By the definition of one great authority these micro-organisms "are the lowest members of the vegetable kingdom, closely related to the lower algæ. They divide themselves in a series of species, well defined by growth and form, which do not run into each other. Of the forms in which bacteria appear, we know the globular bacilli or micrococci[1]; the rod-shaped bacteria or bacilli; and the screw-shaped bacteria or spirillæ."[2]

[1] *Κόκκος*: a berry.
Bacillus: a rod.
Spira: a coil.
βακτήριον: a small stick or staff.

[2] *Text-Book of Bacteriology*, p. 5, by Carl Fraenkel, M.D., Professor of Hygiene, University of Heidelberg. Trans-

Many are endowed with great powers of movement; others, as in the case of the consumption bacillus, are immobile.

But all these organisms named in general "bacteria" are not by any means injurious; most are far otherwise. "Many of the processes of every-day life are intimately associated with the specific activities" of these almost infinitely small forms of life, "and it is now proved beyond all dispute that their presence is not merely accidental, but is absolutely essential to the carrying on of, one might almost say, the most commonplace operations."[1] The alterations in milk, butter, cheese, beer, many of the processes of digestion—in fact, all fermentative and putrefactive changes, the wholesome or unwholesome, are the product of the action or presence of bacterial forms which

lated and edited by J. H. Linsley, M.D., University of Vermont.

[1] *Bacteria and their Products*, p. 8. Dr. G. Sims Woodhead, M.D., Director of the Laboratories of the Royal College of Physicians (Lond.) and Surgeons (Eng.).

thus enter for good or evil into almost every phase of the economy of life. "Whenever and wherever there is decomposition of organic matter, whether it be in the case of an herb or an oak, of a worm or a whale, the work is exclusively done by infinitely small organisms. They are the important, almost the only, agents of universal hygiene; they clear away, more quickly than the dogs of Constantinople or the wild beasts of the desert, the remains of all that has had life; they protect the living against the dead; they do more; if there are still living beings, if, since the hundreds of centuries the world has been inhabited, life continues, it is to them we owe it." [1] "Without them the surface of the earth would be covered with dead organic matter, the remains of plants and animal bodies which, retaining the elements necessary for the building up of new plant life and animal bodies, would soon cut off the food

[1] Pasteur's conclusions stated by Duclaux, translated in *Bacteria and their Products*, pp. 68, 69.

supply of new plants and animals; life would be impossible, because the work of death would be incomplete, or, as Pasteur puts it, 'because the return to the atmosphere and to the mineral kingdom of all that has ceased to live would be totally suspended.'"[1]

The bacteria "and their spores are found everywhere in nature and in enormous numbers. They float in the air; in large numbers in the air of factories, towns, and inhabited rooms; in woods and forests; in smaller numbers in the air in the open country; still fewer at higher altitudes; and in the air on the glaciers in Switzerland, for example, they are almost, if not entirely, absent. They are certainly present in water; the more stagnant the water is the more numerous they are; they pass through the ordinary filters, and are, therefore, numerous in drinking-water. The surface of the animal body is covered with them, and in the mouth and parts of the alimentary canal they

[1] *Bacteria and their Products*, p. 69.

flourish in great luxuriance. All dust contains them, and the soil is the special habitat of many forms of the greatest importance in the plan of nature." [1]

"There is, indeed, scarcely anything that is free from these minute, invisible, living forms. The great masses which surround us—the air, the earth, the water—are as much stocked with them as are the objects of daily use; the majority of our vegetables, our clothing, and our dwellings, our intestinal canal and the surface of our skin, swarm with micro-organisms, and we only know one field which is unimpregnable to them, and that is the uninjured, unaltered healthy organs and juices of the bodies of men and animals." [2]

"The air of our dwelling-places contains on an average three to five germs in a litre; the surrounding atmosphere is usually of the same

[1] Cheyne, *Public Health Laboratory Work.*

[2] Fraenkel, p. 15

composition; there are on the whole fewer micro-organisms in winter than in summer; and finally that proportion deviates considerably from the mean, only under special circumstances, such as strong motions, violent agitation, etc. The air of high regions is freer than that of low grounds, and the atmosphere on the sea and the tops of mountains seems to contain no micro-organisms." [1]

"It has been ascertained that the upper parts of the earth, almost everywhere, contain vast quantities of diverse bacteria, partly of pathogenic nature (such as œdema, tetanus, and anthrax bacilli), while the lower strata, even those belonging to the region of underground water (unless forcibly torn from their natural conditions by man), are wanting in or are even free from bacteria . . . River water, especially if near thickly populated districts, contains sometimes so many micro-organisms that even one drop gives rise to several thousand

[1] Fraenkel, p. 350.

colonies on the plate "[1] (of gelatin used for cultivation).

"The intestinal canal is filled throughout its length not only with germs but with fully developed *vibriones*,[2] which Leeuwenhoek had already observed. These vibriones are a great advance on the germs on the surface" (of the body). "They are producers of diastases which can liquefy not only caseine, but fibrine. They cover the walls and fill the interior of a tube much less resistant than the skin. They even penetrate . . . into the depths of certain conduits developing into the intestine, for example in the pancreatic canal."[3]

More than one hundred forms have been found in and about the mouth. "Six may be said to be invariably present,"[4] some of which are the

[1] Fraenkel, pp. 352, 354.

[2] Forms furnished with a small filamentary appendix, and of a rapid vibratory movement.

[3] Duclaux, "Microbiologie"; *Encyclopédie Chimique*, p. 731.

[4] *Bacteria and their products*, p. 338.

instruments of the development of caries of the teeth, others giving rise to the deposit of "tartar"; more than a hundred forms are in and about the skin. The saliva "is populous with different and very numerous existences, ordinarily in the form of quite short filaments, but able in certain conditions, for example after a night of repose or in certain pathologic conditions, to develop into very long filaments."[1]

It is to these M. Duclaux ascribes much of the work of digestion.

The round forms (cocci) are about 1-25,000 of an inch in diameter, and the elongated (bacilli) are from 1-12,000 to 1-6,000 of an inch in length, with about the same thickness as the diameter of the cocci. It would thus take 25,000 of the cocci laid side by side, or from 6,000 to 12,000 of the bacilli laid end to end, to make one inch in length. Reproduction is largely by sub-division, each part into which the bacterium separates quickly attaining the usual full size.

[1] Duclaux, *Chimie Biolog.* p. 793.

Many forms, and amongst them most of the pathogenic (disease-producing), give off spores. "At the commencement of the spore formation, the protoplasmic contents of the bacterial cell concentrate at certain points which appear to the eye as darker portions of different refractive power. These coalesce while the rest of the cell contents becomes clear and light-colored. The fully formed spore then appears as a strongly refracting, bright gleaming body of definite (generally egg-shaped) form, with a regular dark outline, a thick spore membrane surrounded by the rest of the spore-bearing cell, which is as clear as water.

"The latter soon perishes entirely, the membrane dissolves and disappears, the spore is free, and the process is at an end." [1]

The power of spore production is a weighty element in the preservation of many of the most virulent types. Many of these withstand

[1] Fraenkel, p. 11.

an intense degree of cold, and though rendered inactive for a time resume their normal activity with a return to normal temperature. Duclaux (*Chimie Biologique*, p. 822) states that "M. Gibier has found that a cold of—45° C (49° below zero Fahrenheit) prolonged for five hours did not prevent certain virulent microbes, as *Anthrax charbonneux* (of splenic fever), the *Vibrion septique* (of malignant œdema), and the microbe of symptomatic anthrax, from being inoculated in the organism."

Macé cites experiments of vitality undestroyed at still much lower temperatures, and says: "It has been proved . . . that temperatures slightly below freezing have very little effect on bacteria; bacteriological analysis of samples of ice has revealed the presence of a great number of bacteria when the ice was formed from impure water. Ice can thus transmit pathogenic germs, the same as the water from which it comes. Certain species appear to give way little by little; others sup-

port freezing a very long time. Mitchell (*The Medical Record* 1887) has remarked that the *Micro-coccus pyogenes aureus*" (a bacillus associated with the production of pus) "and the bacillus typhus resisted freezing perfectly for one hundred and three days. On the other hand, the *Micrococcus prodigiosus* and the *Proteus vulgaris* disappeared after five days' freezing. The conclusions to be drawn from these observations and from the researches of Fraenkel and of Prudden are that prolonged freezing does not kill the greater part of the bacteria, but causes a cessation of development, which begins again as soon as the cold disappears; a prolonged cold can nevertheless diminish considerably the number. . . .

"According to Brefeld, the development of the *Bacillus subtilis* (hay bacillus) takes place between 6° and 50° C. (43° and 122° F.), with the greatest activity at about 30° (86° F.). The *Bacillus anthracis* begins to multiply by division at 15° C. (59° F.); it continues until

43° (109° F.), being at its best between 20° and 25° C. (68° and 77° F.). Koch has observed that the bacillus of consumption only increases between 28° and 42° C. (82° and 108° F.), and it is at its best at 37° to 38° C. (98½° and 100½° F.)." [1] "Roughly speaking all pathogenic bacteria grow best at the temperature of the blood, and non-pathogenic bacteria at the ordinary temperature of the room." [2]

"The greatest number of microbes cannot easily develop at all beyond 45° C. (113° F.), and the temperatures of 50° and 60° C. (122° and 140° F.) are considered for the greater number of them as the extreme limits within which they can develop; still, some microbes have been found in water, particularly in thermal waters, which were able to multiply at 64° and 74° C. (147° and 165° F.)." [3]

[1] *Traité Pratique de Bactériologie*, pp. 63, 64.

[2] Cruikshank, p. 170.

[3] Miguel, Van Tighem, Certes, and Garrigou. *Annales de l'Institut Pasteur*, 1888, p. 102.

To produce and complete destruction, however, one must go to a much higher heat. "Most bacteria in their usual forms cannot survive a temperature of about 60° C. (140° F.), while their spores are in no way affected." [1]

"The extraordinary capacity of resistance to external influence must be regarded as the most remarkable property of the spore. This is no doubt owing to the stout, firm membrane which surrounds it and which possesses an almost unlimited power of resistance. . . . One must in fact regard them as the most enduring organic formations of our world." [2] The only thorough means of sterilization or disinfection seems to be the use of steam, which is "explained by the fact that the tough covering of the spore, the very touchstone of all disinfecting processes, swells and softens on coming into contact with the moisture, and thus becomes permeable, as has been proved by the

[1] *Fraenkel*, p. 70.

[2] *Idem.*, p. 14.

experiments of Esmarch." [1] A complete disinfection thus requires that the steam should reach easily all parts of the material; close folds or rolls, as shown by experience, will produce a failure.

We can thus understand how the germs of disease, as, for instance, those of scarlet fever, may be preserved even many months, ready to renew their activity in the human body if no other field than man is in the meanwhile provided.

Besides a susceptibility to varying temperatures, there are great differences as to the effect of the presence of oxygen. This fact divides bacteria into the aërobic, to which oxygen is a necessity, and the anaërobic, which can only exist with but little or no oxygen. To the latter class belong most of the disease-producers. "All micro-organisms that are to exist as parasites must . . . be able to

[1] Fraenkel, p. 70.

live without oxygen, at least under certain circumstances."[1]

A third important influence is light, as shown by Duclaux[2] and Roux,[2] and by Pansini, among the conclusions of the last of whom, cited by Macé,[3] are:

That diffused light has a retarding influence on the development of micro-organisms;

That the direct light of the sun has a really sterilizing action besides a retarding action on development;

That a sterilizing action properly so-called is produced when the rays of the sun fall perpendicularly, or nearly so, on the surface of cultures;

That the sterilizing and retarding action of light requires a variable time according to the micro-organism.

All investigations of this character, thus far,

[1] Fraenkel, p. 19.

[2] *Annales de l'Institut Pasteur*, 1887, pp. 88, 415.

[3] *Traité Pratique de Bactériologie*, p. 70.

go to show that bacteria of a disease-producing character flourish in hidden and dark places, and perish, or at least become much less virulent in the light and air. These two are thus the great purifiers, and the lesson, taken to heart, should put an end to the concealment of garments in closets or the want of access of light to soiled clothing.

Besides the great results of the work of Pasteur and his fellow-laborers, due to the discovery of the ability to isolate and cultivate bacteria in various nutrient mediums as bouillon, gelatin, on the surface of boiled potato, etc., we have the knowledge that bacteria may be cultivated to a lower vitality at will through exhaustion of their nutriment, by cultivation at a higher heat, by subjecting them to certain chemical conditions, or even by cultivating them in certain organisms upon which the results of their action are not so virulent as in other animals. They may be brought to such a degree of "attenuation" that the most

susceptible organism may be inoculated without danger, and inoculations of the same micro-organism of a greater strength may be successively undergone until the most powerful may be withstood without harm or any apparent effect.

The organism has then acquired immunity against the effects of the specific micro-organism. This condition and its causes (of which we have analogies long recognized in immunity from later attacks of those who have suffered from smallpox, scarlet fever, and diseases of like types) are still among the things inexplicable, though they would seem to be the results of a sort of Darwinian evolution "by a gradual functional adaptation and also by a kind of selection in which only the strongest and most vigorous cells remain and transmit the acquired faculty to their descendants." [1]

Bacteria are broadly divided into pathogenic (disease-producing) and non-pathogenic, the

[1] Metschnikoff, quoted by Fraenkel, p. 146.

latter being largely associated with the ordinary changes which have become so familiar as to be unnoticed parts of daily life.

As already stated, great numbers of the latter class are at all times associated with our own organisms, and some of the former are frequently found in connection with perfectly healthy persons, as, for instance, the pneumococcus of A. Fraenkel, which, to quote Dr. Carl Fraenkel "are by no means exclusively found in pneumonia; they are, on the contrary, very extensively diffused. They are found in almost all cases of cerebro-spinal meningitis (as proved by Foa and Bordoni-Uffreduzzi), and the origin of this affection is reasonably attributed to them. A. Fraenkel has found them present in pleuritis; Weichselmann, in peritonitis; Banti, in pericarditis. Other investigators have encountered them in endocarditis, and otitis media, and numerous other affections. They occur especially in the saliva and nasal secretions (as established by Netter), and

they may be regarded as regular tenants of these localities." [1]

The streptococcus pyogenes, a form which plays an important part in producing suppuration, also has diverse associations: "It is found very frequently in the saliva, in nasal secretions, in vaginal mucus, and in the urethra of healthy individuals; on the other hand, it regularly appears whenever the normal condition of the tissue is disturbed by some morbid process.

"It was seen to appear in typhoid and diphtheria as a 'secondary' bacterium, concomitant with certain changes; it gives rise to a mixed infection in pneumonia, tuberculosis, pleuritis, scarlet fever, etc.; it may in many cases be the cause of more severe conditions than the legitimate micro-organisms.

"Finally the streptococcus by itself may produce sharply characterized inflammatory processes. When it reaches the valves of the

[1] Fraenkel, p. 310.

heart, it causes a typical *endocarditis* (hence a third exciter of infection); if transplanted in the endometrium of lying-in women, it causes *puerperal fever*, and it does so exclusively according to all investigations hitherto made; on entering the lympathic vessels of the cutis, it gives rise to *erysipelas;* if admitted to the subcutaneous tissue or the serous cavities, it produces *purulent changes*, distinguished by a pronounced inclination to spread slowly and to continue its existence without "breaking down," and often manifesting an especially malignant character."[1]

The advance in the knowledge of the manipulation of these small forms for examination has been such that they are much more readily determined than they were even a short time since. Anilin color particularly is readily taken up by most forms of bacteria, certain forms having a special affinity for certain colors.

[1] Fraenkel pp. 327, 328.

This enables the bacteria to be clearly distinguished, frequently standing out as beautifully colored shapes with the greatest distinctiveness from the material with which they are associated.

Of all these minute creatures, from the frequency and malignancy of the disease with which it is associated, the tubercle (or consumption) bacillus is the most interesting, perhaps, to men in general, and its description, paraphrased from Dr. Woodhead's *Bacteria and their Products* should have a place.

They are when stained seen as rods or threads from 1-16,000 to 1-7,000 of an inch in length and about 1-125,000 in thickness; they are usually slightly curved, or two are arranged end to end so as to contain an angle. It has been demonstrated by Cheyne that from two to six spores may be seen in these rods.[1] It is non-motile. "The association of this organism with

[1] This is held by Fraenkel not to be proved.—(F. E. C.)

tubercular disease is undoubted : it is found in the lungs and sputum in various forms of consumption ; it is found also in the tubercular ulcers of the intestine, around the vessels in tubercular inflammation of the membranes of the brain,—a condition which occurs frequently in children, in tubercle of the liver and of all other organs of the body, and in tubercular eruptions of the skin such as lupus." It is cultivated outside the body with great difficulty, grows best at the temperature of the human body, and its activity of development is much lowered by any change from this temperature. It may be exposed for a considerable time to low temperatures, but resumes its activity when restored to favoring conditions. Desiccation, which is fatal to the growth and virulence of the cholera bacillus, interferes but slightly with that of tubercle.

As guinea-pigs, rabbits, and other animals have been successfully inoculated with the

tubercle bacillus, it is held that consumption thus becomes an infectious disease. The air of the wards in which consumptive patients are kept has been shown to contain the bacilli of the disease, and as their activity is not destroyed by drying, we can reckon upon being generally in contact with these forms, arising from dried sputum, etc. Much stress is thus being laid upon the necessity of care in regard to the habits of consumptive patients and of care as to their handkerchiefs and clothing.

Whatever may be the views of individuals as to the effects of want of such care, there is one consolation to those who may be alarmed by the present state of the medical mind on this subject, viz., that there are very few germs, if any, in the air breathed from the lungs. "Experiments demonstrate clearly that the air expired is almost completely free of germs. The lung plays really the rôle of filter which Lister attributes to it," and "it is necessary to draw the conclusion that men or animals brought to-

gether in a confined space, far from soiling the air as regards microbes, tend, on the contrary, by their respiration to purify it."[1] The same author also expressly states that from a great number of experiments of others on the air expired by phthisical patients, the presence of neither the consumptive bacillus nor its spores has been detected.

Milk, besides being frequently subject to this particular bacterium, is a most excellent medium for the growth of a very great variety of bacteria. It cannot remain exposed to the air under ordinary circumstances of temperature without at once being occupied by some of the many forms associated with its ordinary changes: such, for instance, is the color formed in "blue milk," which is due to the action of a micro-organism. But it may of course at the same time be seized upon by organisms much more injurious to human life. The only

[1] Straus, "Sur l'absence de microbes dans l'air expiré," *Annales de l'Institut Pasteur*, 1888.

milk quite safe to use for children, especially those of feeble physique, is that sterilized by boiling under pressure at about 250° F. for ten or fifteen minutes, or at the usual pressure of the open air twice or thrice at intervals of about six hours; this interval under the latter circumstances being necessary in order to destroy the bacilli developed from spores undestroyed by the previous boiling.

Why should the presence of some forms of bacteria cause disease?

M. Roux says: "An infectious malady is a poisoning; the source of the poison is the microbe installed in the tissues; it there elaborates its toxine at the expense of the substance of the living creature itself which it is going to cause to perish. A proof that this is so is that we can obtain from the corpse itself the poison which we find in the cultures."[1]

"Although our present knowledge of the

[1] *Annales d'la Institut Pasteur*, 1891, p. 519.

subject may still be very deficient, and though it may call loudly for completion, yet, from what we do know, we may safely lay down the proposition: the action of the pathogenic bacteria is chiefly to be explained by their producing specific, extremely poisonous substances which seriously injure the organism, influencing it in a definite manner and thereby causing definite independent forms of diseases.

"Just as the small portion of poison injected by the sting of a bee or the tooth of a serpent suffices to cause local derangements of considerable extent, to cause disturbance in the whole organism or even to kill, so also the bacteria, by means of their toxine, are under some circumstances able to affect parts with which they come into no direct communication. In this way we must explain the cases in which a general derangement of the bodily functions reveals a violent disease, and yet the most careful search only finds a very limited number of micro-organisms, or only finds them limited

to one particular portion of the body, which for some reason or other they adhere to exclusively. In the latter case they have excreted their poison in their chosen quarters; it has been carried far and wide by the blood and other juices, and its noxious effects are seen wherever it has penetrated." [1]

This theory seems the only logical one; like all beings with life they must give off products, the presence of which in the organism is abnormal, and being abnormal must, following the universal law, create disturbance. In tetanus (lockjaw), the cause would seem curiously small compared with results. The microbe, which is one of the most widespread, existing particularly in the soil about stables, in manure heaps, about harness, etc., and which will only flourish when excluded from light and air, is never found but in the immediate vicinity of the wound. The paralyzing poison evolved, which is very slow

[1] Fraenkel, p. 122.

in extending its effects, is evidently chemical in action. The same may be said of the bacteria of diphtheria, which do not wander from the locality of the throat; logical reasoning would also lead us "to combat the further increase of bacteria already in the body by the use of means known to possess qualities hostile to bacterial life and calculated to kill bacterial germs. The natural powers of the organism are in this case not called into requisition; but an artificial aid, to which they stood in no relation previously, is offered to them.

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"Unfortunately, the results obtained by this method have by no means fulfilled the hopes with which it was at first welcomed. All the substances which, outside the body in the test tube have a decided influence on the micro-organisms are powerless in the living tissues unless they are employed in doses which would be directly deleterious to the body, and would destroy it even more quickly than the bacteria would have done. Yet it would be

unwise to give up in despair on account of the want of success hitherto secured. The valuable results obtained by the purely empirical treatment of malaria with quinine and of syphilis with mercury, encourage us to persevere and warn us against a too early abandonment of our efforts." [1]

The allusion to quinine and mercury, the only two medicines in the whole pharmacopœia which may be called specifics, holds out the real hope that, for diseases of certain types, specifics are possible which will neutralize the poison evolved by the bacteria. The hope appears most reasonable in such as diphtheria, scarlet fever, smallpox, tetanus, typhoid, and cholera. Much less so, as I believe, for reasons further on, in such as consumption, Bright's disease, or chronic catarrh.

From the cultures of very many forms of bacteria, poisonous alkaloids have been separated which injected give the symptoms of the

[1] Fraenkel, pp. 148, 149.

diseases with which the specific bacteria are associated.

"The importance of the presence of these substances in pure cultivations of pathogenic organisms can scarcely be overestimated. In the vegetable kingdom there are recognized whole series of substances that have an alkaline reaction, combine with acids to form salts, are evidently formed by the protoplasm of the plants in which they are found, and which, injected into the tissues of an animal or taken by the stomach, exert a most energetic poisonous action either upon the end organs in muscles or upon the muscles themselves. Of these we may take such well-known examples as strychnine, atropine, nicotine, cinchonine, thebaïne, morphine, brucine, and others. They are all built up by vegetable cells and all exert a specific action upon animals. Similarly it is found that bacteria—minute vegetable organisms—can build up substances as they grow in dead or living animal tissues, in which they live

as saprophytes or parasites, which substances exert a most deadly influence on the nerve centres or the parts above mentioned of animals in which they are found or into which they may be injected, but in addition have an extremely injurious local "caustic" influence, giving rise in many cases to the death of the tissues with which they may have come in contact at the points where the poison is formed, or at the seat of inoculation. Thus tetanine[1] is a substance that appears to act through the nervous system much as does the alkaloid strychnine."[2]

We have familiar examples in some of the toxines met with in ordinary life in the poisoning resulting from eating ice-cream which has been made under certain circumstances, or that arising from eating shellfish or fish in which a certain decomposition has set up. There can

[1] The alkaloid derived from the tetanus (lockjaw) bacillus. (F. E. C.)

[2] *Bacteria and their Products*, p. 358.

be little doubt that they are all intimately akin, whether found in such materials as those just named, or in the human body, alive or dead; and it is probable we shall soon recognize that it is to such toxines, elaborated in our own bodies and as poisonous in character as any produced elsewhere, we must ascribe (among other ailments) langour and depression after eating, headaches, nausea, stupor, and the ill feelings accompanying indigestion: all the result of a poisoning as real, though it may differ in intensity, as that produced by any of the poisons from the chemist's laboratory.[1]

The older ideas regarding infection are gradually dissipating. We all can remember the time when to have had contact with small-pox was regarded as almost equivalent to catching the disease; to breathe the air of any infection was to suffer. Dr. Burdon Sanderson well expresses this in saying:

[1] *Vide. The Animal Alkaloids:* Sir William Aitken, M.D., F.R.S.

"When twenty years ago we first began to think of microphytes as causes of specific disease, we were too apt to assume (and I willingly admit that I thought and said so myself) that all that was necessary for the production of a disease was the sowing of the seed, and that, if once the fatal germ found entrance, it would certainly

> " ' Like pitted speck in garnered fruit,
> Rotting inwards, slowly moulder all.'

"Whether the number of seeds sown were one or a myriad, it was thought that, although the question of catching or not catching an infection was, so far as external conditions were concerned, a matter of chance, inside the organism, it was simply a question of cultivation and vegetative multiplication; as if the contagium, instead of having to make its way against innumerable hostile influences, were as certain to develop in the living organism as it would be in a flask of bouillon. . . .

"At that time (1869) the ideas of pathologists as to the origin of infective diseases were vague; contagia were regarded as vaporous or gaseous, and 'sewer gas' in particular was thought to be capable of producing any of the zymotic diseases." [1]

This change of mental position has had a momentous bearing upon the whole question of hygiene. It practically means that we know that, though exposed at all times to the attacks of a very large number of forms of disease-producing germs, it depends upon the physical condition of the individual as to whether or no he shall be unconscious that the germs even exist.

A name closely connected with this change of view is that of the Russian Metschnikoff, now of the Institut Pasteur, at Paris, who holds "that the protection against the attacks of micro-organisms in the body is entirely due to the action of amœboid cells of the body; that these cells are living pieces of protoplasm, that

[1] Lecture, *Lancet*, Nov. 21, 1891.

they are constantly taking into their own substance all foreign particles which find their way into the body, that wherever there is an extra demand on their energies a large number are attracted to the point at which work is to be done, and that these cells acting on the micro-organisms just as they do on foreign bodies, take them up into their substance, digest and convert them partly to their own uses, and gradually throw into the circulating fluids of the body small quantities of effete substances, which are removed by the ordinary physiological channels." [1]

Metschnikoff's own account of his work is as follows:

"In order to better observe the phenomenon mentioned, I have chosen very transparent animals, such as the daphnias" (water fleas), "little fresh-water crustaceans, which are often subject to parasitic attacks of an inferior mushroom of the yeast family (*Monospora bicuspi-*

[1] Dr. G. Sims Woodhead.

data). The spores of the parasite, in the form of long needles, enter the alimentary canal with the food, whence, perforating the walls of the intestine, they introduce themselves into the cavity of the body of the daphnia. But as soon as the spores appear beyond the intestine, it immediately engages in a contest with the leucocytes,[1] which singly or together fall upon the spore, and transform it into a mass of formless particles, thus saving the animal from the danger to which it was exposed.

"While in the majority (eighty per cent.) of the infected daphnias, this prophylactic rôle of the leucocytes attains its end; in rarer cases (twenty per cent.), the spores escape their action and succeed in germinating, giving off a considerable number of conidia, which in a short time overrun the cavity of the entire body, and end by killing the animal. In such a case, after the malady is established, the leu-

[1] λευκός, white, κύτος, a hollow,—a white corpuscle of the blood or lymph.

cocytes continue the fight by incorporating a part of the conidia, but as these latter multiply rapidly and destroy the phagocytes,[1] the victory always remains on the side of the parasite."[2]

The annunciation and propagation of Metschnikoff's theory as applied to the action in general of the leucocytes of all animal bodies, to which the name phagocytosis was given, has been followed by a vigorous discussion and contention, in which the opponents of the theory hold that the destructive power rests elsewhere, and the white corpuscles play but a secondary rôle, viz., that of devourers of the micro-organisms after they are destroyed through other activities of the body. "Buchner maintains that the cause of recovery of an animal from an attack of infectious disease is not due to the action of phagocytosis, but to the disinfecting action of the serum."[3]

[1] φαγεῖν, to eat.

[2] *Annales de l'Institut Pasteur*, 1887.

[3] Dr. G. Sims Woodhead, "Bearing of Recent Biological

Dr. Burdon Sanderson says "the organism (*i. e.*, the living human or animal body) possesses means of arresting the development within itself of pathogenic microphytes [1] and of eventually destroying them . . . that this function resides both in the blood and the tissues, both in the organized protoplasm and in the intercellular liquid, that the inhibitory or destructive action is chemical." M. Roux, on the other hand, says, numerous facts show "that the microbes seized by the cells are not devitalized but are in full activity," that "the phagocytes absorb the microbes, not only living but still virulent." [2] M. Ruffer states: "Further researches . . . have confirmed me in my former opinion, that the destruction of the micro-organisms in living tissues is accomplished by the cells of the body and the

Researches on the Practice of Medicine and Surgery," *Lancet*, January 9, 1892.

[1] φυτόν, plant.

[2] *Annales de l'Institut Pasteur*, vol. v., p. 529.

cells only." The French school thus, in general supports Metschnikoff, the German holding, as a rule, to the theory that the basis of the destruction is a quality of the serum of the blood.

Dr. G. Sims Woodhead, referring especially to suppuration, says[1]: "If Metschnikoff's phagocytes have taught us nothing else, they have brought into prominence the all-important fact, that before repair of any kind can go on in the body, all injured and dead tissues must be removed. If they are not removed by the surgeon, or are actually brought into existence by the surgeon's knife, or by his rough handling or injudicious use of chemical substances, they will be removed by a force of scavenging phagocytes that will be brought up for the purpose. And until these have done their work, the process of repair cannot be completed; for suppuration, whether in a wound on a small scale or in an abscess on a large scale, is the

[1] *Lancet*, January 30, 1892.

result of an attempt on the part of the organism to free itself of materials that are interfering with the process of repair."

Thus the small pustular eruptions so frequent, the occasional inflammations at the corners of the nail, the almost unnoticed troubles from small cuts and bruises, which may be painful in healing, are all due to the ever-ready microbe which has obtained a foothold.

But the great and broad and satisfactory fact has been established that there is this battle between our organism and its assailants, and that a healthy body has no difficulty in holding its own; or, in the words of Dr. Burdon Sanderson: "The organism of man and of the higher animals possesses a self-protecting power, which it can exercise either in arresting the development of the living exciters of disease or in counteracting their poisonous products—in other words, it is endowed not only with a general *vis protectrix*, but that it is able

to bring into existence specific vital activities by which it guards itself against the specific infections to which it is exposed, and (what is practically most important) that these activities have chemical embodiments which are within the reach of experimental investigation.

"To have learnt this is to have entered on the beginning of a new progress—to have turned over a new leaf in Pathology and in Preventive Medicine.

"It seems to me to require no prophetic power to foresee that we are just now on the threshold of discoveries which will surpass in their practical value, no less than in their scientific importance, all that have preceded and led up to them. Happy are they who are young enough to hope to participate in the realization of so encouraging a prospect." [1]

[1] "Lecture on the Origin and Nature of Infectious Diseases," *Lancet*, November 21, 1891.

III.

THE preceding chapter is, I believe, a fair statement of the present views of the scientific world as to the connection of bacteria and disease. Though there are differences—and very great differences—upon points of high importance from a scientific standpoint, the following from a practical point of view are, I think, safe and fair deductions:

1st. That micro-organisms (bacteria) are ever present in great numbers of forms,—in the air, water, soil; in the intestines and other passages, and in all dead organic matter.

2d. That they are the means by which all fermentative and putrefactive (and largely digestive) changes are brought about.

3d. That they are the universal scavengers, appearing wherever they can find proper nutri-

ment in animate or inanimate matter; that if they appear in the former, it is frequently as the accompaniment of disease,—the disease, in some cases at least, being the result of their presence.

4th. That there is a resistance on the part of the living organism to such presence, the strength of this resistance being either in a chemical quality of the blood serum or in a power of the white corpuscles of the blood to actually attack and devour the invaders, or in both.

5th. That a moderate temperature, moisture, want of light and oxygen, are specially favorable to most of those forms associated with disease.

6th. That bacteria may be cultivated artificially to a high degree of vitality and thus rendered very vigorous in attack, or a depressed vitality may be brought about, in which latter state even those species regarded as most dangerous to life may be injected into the organ-

ism without special injury; that successive doses of the same species of increasing vitality may be thus administered until the organism is safe from even the most virulent of that species, or, in other phrase, is "immune" against all ill effects from the presence of that specific micro-organism.

In vaccination we have the most familiar form of this process.

A great and most important question becomes: "Are there not many forms which would not appear at all in the living organism if there were no scavenging to be done?" In other words if the theory of the first chapter regarding the necessity of keeping up the rate of change and thus allowing no dead matter to accumulate be successfully acted upon, would there be the so-called assault upon our organism typified by such forms of disease as phthisis, catarrh, Bright's disease? I venture to say No! that we should be immune from

such so long as no alarm was rung to call the bacterial policeman who under the law by which he exists must come if needed. The whole series of dread diseases just named, or in a word organic disease in general, may thus be defined as the result of a failure of elimination, the third in sequence, but the first in importance, of the trio, of which the other two are nutrition and assimilation, necessary to health.

Should we not thus recognize a difference in character between the causes of bacterial life in organs such as the lungs, and those which have their life in man in the throat (*e.g.* in diphtheria) or in the intestines (as in typhoid and cholera). The former it is likely are true parasites, ever present with us; necessary existences for a particular sort of scavenging: the latter may have merely an adventitious life in the human organism, accidentally introduced and happening to flourish in a congenial soil. This would

appear not unreasonable. The chances are certainly in favor of this theory when we recognize such a fact as the almost constant presence of the pneumonia bacillus, only one of many forms which may be injurious. It is much more than likely that the bacillus of consumption, which "is a strictly parasitic micro-organism, that can only with difficulty be cultivated outside the body," and which is not alone in the material given off from the lungs, as the "expectoration from consumptives is usually very rich in foreign micro-organisms, especially streptococci [1] and bacilli of decomposition," [2] may have the same familiar character.

Following the logic of these views, Dr. Koch's theory as to the possibility of the cure of consumption by an injection of a preparation of what may be called the dejecta of the bacillus of consumption must of necessity be an error, and I would say that I have held this

[1] Linked cocci.

[2] Fraenkel, p. 230.

view from the time of first publication of his supposed cure. That, as previously said, it may be possible with the advance of knowledge to introduce into the circulation a poison for any specific micro-organism, of whatever type, is undoubtedly true; but it seems unreasonable to suppose the death of the slow-growing immobile microphyte of consumption, especially when this death must be brought about by a starvation produced by a rapid necrosis of its immediate surroundings,[1] can go far towards effecting a complete change in the degenerative process taking place in the diseased lungs. That it may aid somewhat, yes; foreign living organisms anywhere in the living material of our bodies must give rise to dejecta which are unwholesome under such conditions. This is a law of nature, and these must at least aid in setting up morbific processes; but in the case of consumption of the

[1] See Koch's explanation as given in *Bacteria and their Products*, pp. 234–237.

lungs, failure to cast off worn-out material will I believe (as in all organic diseases) surely be found the first, the most potent and the only real cause.

If it can be shown that the effects accompanying consumption are through a poison of which the attendant bacillus is the producer, as in the case (in all probability) of various fevers, smallpox, diphtheria, tetanus, etc., in which toxic action is evident, the case would be different. Antidotes to poisons of this class will undoubtedly be found, as antidotes have been found for the poisons of malarial fever (by quinine), and of syphilis (by mercury). Thus far this is the sum of discovery in this direction, but it must be remembered that these were found purely empirically, and that nothing but empiricism until to-day existed. We no longer shall work in the dark, but in the broad light of a day of which this is the brilliant dawn.

Though so much stress is laid upon the possibility of contagion from the straying tubercle

bacillus, Dr. J. T. Mays, of Philadelphia, quotes in a pamphlet opposing the theory that phthisis is contagious, the statistics of Brompton Hospital "which show that in thirty-six years not a single authenticated case of phthisis arose within its walls among its 280 physicians, residents, and nurses of which there existed a health record."

Dr. Mays quotes Dr. Schnyder of Switzerland, who gives a record of 844 cases of phthisis occurring among married people. In 445 of these the husband only was phthisical, and in 367, the wife only, while in 32 both husband and wife were affected, showing that in 812 cases there was not the least proof of contagion." [1]

Returning to Dr. Koch's remedy, I will even venture the apparent paradox that it is most fortunate for the world that it should have failed. Humanity is not to be advanced by

[1] *Lancet*, September 19, 1891.

trusting altogether to the injection of a minute globule of lymph for health. Were it so, it would soon be a world of weaklings instead of the strong. To look forward to thus neutralizing acute poisons, such as those of cholera or diphtheria, is logical, but the ability to call upon such a remedy for any disease whatever would be at once destructive of the cultivation of the physique, which is one of the marks of the present age, as it was of the noble period of Greece. It is by calling up the vigor which will render disease and its concomitant weakness impossible ; by the cultivation of the idea that chronic diseases are loathsome and degrading, an evidence of inattention to a highest duty both to ourselves and to our fellow men, that the physique of man is to be elevated, and, in a very great degree, his morals improved.

But all this is but secondary to the great question of prevention ; the question of how

to avoid sickness, or, in other words, keep up this perfect elimination or change which physical law demands. If we change with the almost torrential rapidity or anything like it, mentioned in the first chapter, it means that the greatest care must be observed to throw no hindrance in the way; that the least obstruction to the laws governing elimination is an injury subjecting us to danger; no doubt in ordinary cases not great, but certainly appreciable.

A perfect and normal working of the processes of elimination thus becomes the one, sole, and vital basis of what we understand by physical health.

Dr. Sims Woodhead well puts this in applying it to questions of surgical treatment, but his words have a far wider application. "It may be pointed out that the maintenance of the excretory organs in good working conditions is one of the most important elements in the success of antiseptic surgical treatment. Even from the point of view of the most ardent

believer in phagocytosis this will be admitted; whilst those who believe in the microbicidal action of the fluid elements of the serum will be equally ready to accept it. Not only do the effete substances of the tissues, if retained for any length of time, exert a poisonous action on the tissues themselves, but all poisonous products of certain bacteria formed within the body, and certain poisonous substances taken into the body from without, are all excreted in the same manner; for instance, if cholera poison is injected subcutaneously or intravenously, hemorrhages will be found to occur in parts of the alimentary tract; whilst following the exhibition of other poisons, although no regular hemorrhages occur, intense congestion is found, and the poisonous substance is formed in the alimentary canal, showing that in both cases an effort has been made on the part of the organism to get rid of the poison by the ordinary excretory channels. This being the case, it is of the very greatest importance that the intes-

tinal tract especially should be kept free from accumulations of effete matter. First, in order that such matter may not be re-absorbed ; and, secondly, to allow of a free passage outwards of any substance which may interfere (*a*) with the free action of the leucocytes and of the other cellular tissues, and (*b*) with the normal constitution of the fluids of the body.

"The third factor in antiseptic surgery is the cultivation of the *vis medicatrix naturæ*, by which the tissues are to be placed under the best possible conditions, so that the phagocytes or the blood serum may exert to the full their special protecting powers. As is well known, anæmia (where the quantity of blood is small, or the blood is vitiated) may be a powerful factor, indirectly, in the production of pyæmic or septic processes, and any method of preventing the loss of blood, short of depriving the tissues of their blood supply for lengthened periods, is of direct assistance to the surgeon who wishes to keep his wounds aseptic. Simi-

larly, good ventilation acts not only directly in interfering with the growth of pathogenic or pyogenic organisms from wards, but also by improving the general health of the patient; whilst good nutrition and efficient excretion, as already mentioned, play an equally important part in maintaining the resistant powers of the tissues or of the cells of which they are composed."[1]

Sir William Aitken says: "Thus it is that our organism lives on conditions of incessant elementary disintegrations, so that 'we constantly bear about within us the effete debris of our living selves. . . .

"Hence normal health comes to be conditional on an incessant formation, transformation, and elimination of the effete or old organic materials which must give place to the new. It is this effete material (in whatsoever form it is found) which, therefore, represents a series of partial deaths; and which as the result of or-

[1] Lecture, *Lancet*, January 23, 1892.

ganic functional operations, constitutes life, during which the tissues and organs in the processes of their metabolic changes, perform a constant function of disintegration—fabricating during these processes those 'alkaloids' and 'extractives'—'those x, y, z's of pathology,' which must be regarded as veritable '*scoria*' (Brown) or '*physiological ashes*' (Lauder Brunton) resulting from the processes of combustion of the elements of organic tissues." [1] We have in these words the real philosophy of the subject.

The most patent transgression of the laws which govern us, and, in the author's view, the most potent, is the ordinary treatment of the skin, a treatment, under our condition of civilization, unavoidable, in some degree, and which can only be mitigated.

Nature designed that the enormous amount of material exuded from the skin should be

[1] *The Animal Alkaloids.*

carried off and purified largely by the action of light and air. Our clothing prevents this action; it is in parts, as the clothing of the feet, almost air-tight, and is wholly impermeable to light. We thus set up the most perfect conditions possible for the development of pathogenic micro-organisms on the surface of the body, viz.: dead animal matter, the most effective temperature (that of the body), and absence of light. *That by the end of the day the moist surface of our bodies is a teeming mass of such organisms can hardly be doubted; and we are thus encased, after a few hours, in an envelope of active putrefactive change, which must necessarily exert a most depressing action upon the skin, and thence upon our physique in general.* A large portion of the fatigue felt at the end of the day is thus simply the result of this depressive action. Our feet naturally suffer the most, as the conditions to which they are subjected are worse than those of the rest of the person, being more nearly completely ex-

cluded from the air than any other portion of our bodies. The result is found in cold feet, or if not cold there is a hot prickly sensation with a feeling of discomfort and unrest. A change of footgear and a washing of the feet will immediately remove this feeling, by getting rid of the noisome material, which, having come through the skin and not finding escape, thus enters its protest against our violation of law, and remove also the odor, the result of the presence of the *Bacillus fœtidus*, which has put in his appearance as one of nature's scavengers. Many persons complain of damp feet, as if it were not in the nature of man that all feet which are shod should after a few hours be more or less damp through want of ventilation. So long as the skin is healthy and active, it must be throwing off these products, and this is true of the feet as well as of any other part.

How seriously non-attention to the feet may result, apart from the effect upon the general health, is shown by the numerous cases of

blood poisoning following slight wounds of the feet resulting from the cutting of corns, or from abrasions by a nail in the shoe, etc. The poison does not come from the mere wounding, but from the poisonous state of the skin exudation which has come in contact with the wound; and which, as shown, may easily be set up by a very moderate inattention to cleanliness.

A protest may be entered here against the high-laced shoes so generally worn by children and more especially by young girls: few things in the way of foot gear can be more unwholesome.

A few words as to a simple and efficient health-keeping routine which (*experto crede*) will be found effective far beyond its seeming power! This consists simply in a sponge bath [1]

[1] By "sponge bath" is meant that sometimes called the Hip Bath (the English "Tub"). This is furnished in every English hotel or inn for sixpence. The American inn-keeper who will inaugurate such a system will do far more for the

in the morning, followed or preceded, as may be preferred, by a brisk rubbing with a flesh brush; a complete change of clothing before dinner, with at least a washing of the feet, with another rubbing with a flesh brush. In warm weather another sponge bath is both pleasant and effective, and once so much of the habit is formed, the afternoon bath will generally be continued by preference winter and summer.

It may here be incidentally remarked that our American habit of generally using only fixed baths prevents many from taking this daily bath who would like to do so. The ordinary flat sponge bath is quite sufficient for health, as all that an ordinary bath can do in any case is to remove surface impurities; it is always at hand, needs but a trifle of water, and is taken with less trouble than are generally the usual morning ablutions of those who do not bathe at all. If anything more be needed, we

benefit and comfort of our fellow countrymen than all the medicaments of all the pharmacopœias.

should turn to the Turkish bath, which is undoubtedly one of the greatest of health-giving agents. In the author's view there is no more effective means of bringing about that elimination of dead products on which such stress has been laid.

The clothing taken off in the evening should be hung where it will be exposed to the light and air. I mention this particularly, as if put in a dark closet, or rolled and laid out of sight, putrefaction and not purification sets in. This clothing can be put on the next evening; two suits of underclothing being thus kept in use at a time.

This complete change of clothing, *before dinner*, will be found of the greatest benefit to dyspeptics. By restoring the skin circulation to its more normal condition, the digestive functions in common with all the other physical powers are greatly helped. Experience within the author's observation has shown some striking examples of this.

I am well aware of the fact that the simplicity of such advice as above is but too apt to prevent its acceptance, but the preservation of health is only to be effected by recognizing and adhering to the simple and fundamental laws of nature, whose working is always upon the simplest and most direct lines. In such adherence is Health; in transgression, however small and unimportant the transgression may seem, is Disease. True science, and most of all, the science of health-keeping, is in the knowledge of little things. When we come to understand and act upon this, when we shall recognize that our health as a whole depends upon the individual health of the minute elementary cells of the body, which together make up our entirety, we shall have entered upon a new world of hygiene, both physical and moral.

A word more may be said as to the benefit of the instigation of a greater activity of circulation and change in its effect on sleep-

lessness, which in the vast majority of cases is the simple result of indigestion. A diligent rubbing with a flesh brush or frictioning of the stomach, if one finds he cannot sleep, will almost always at once induce slumber. We very frequently hear the cause laid at the door of overwork, but the immediate cause, which of course but too frequently is induced by over-strain and fatigue, is, I believe, to be as stated. We should be capable of any amount of work: we have the whole cosmic energy to call upon; all we need is that the apparatus for its utilization should be in good condition, and so long as the digestive apparatus is in good working order we may be pretty sure we need never hear unwillingly the striking of the hours of early morning.

In putting forward the foregoing I do so as one in no position to do more than merely offer some suggestions which I hope may be found of value. The main necessity is that we should

recognize our wonderful evanescence, the ceaseless flow and renewal as a river always the same river but never the same particles; and the fact that we are, as is every other living thing physically considered, but an expression of the energy of nature, which energy wherever active, in any form whatever, means constant change.

THE END.